

REMARKS

This responds to the Office Action mailed on May 17, 2007.

Independent claims 1 and 8 are amended. Claims 2-3 and 9-10 are canceled. New claims 28-34 are added. As a result, claims 1, 8, and 26-34 are now pending in this application.

Amendments to the Title and Specification

The title has been amended to more accurately reflect the claimed subject matter by substituting “SUBSTRATES AND SYSTEMS TO MINIMIZE” for “ARRANGEMENTS FOR MINIMIZING”.

Applicants have carefully reviewed and edited the entire specification for accuracy and consistency of terminology and grammar. Applicants have also corrected a number of typos. No new matter has been added by way of these amendments to the specification.

Amendments to Claims 1 and 8

Independent claims 1 and 8 have been amended. No new matter has been introduced. Support for all of these amendments may be found in Applicants’ original disclosure.

New Claims 28-34

New claims 28-34 have been added to provide Applicants with additional protection to which Applicants are entitled. New claims 28-34 are supported by the original disclosure. No new matter has been introduced.

Rejection of Claims 1-3, 8-10, 26, and 27
under 35 U.S.C. §103(a)
as Unpatentable over Tsukada
in view of Bhatt and Sweitzer

Claims 1-3, 8-10, 26, and 27 were rejected under 35 U.S.C. §103(a) as being unpatentable over Tsukada et al. (U.S. 5,451,721) in view of Bhatt et al. (U.S. 5,487,218) and Sweitzer (U.S. 5,615,477).

As mentioned above, claims 2-3 and 9-10 have been canceled.

To establish a *prima facie* case of obviousness under 35 U.S.C. §103, the prior art reference (or references when combined) must teach or suggest every limitation of the claim. *In re Royka*, 490 F.2d 981, 180 USPQ 580 (CCPA, 1974). MPEP §2143.

The asserted combination of Tsukada in view of Bhatt and Sweitzer fails to teach or suggest all of the claim limitations present in independent claims 1 and 8, as amended, so a *prima facie* case of obviousness has not been established.

Tsukada appears to disclose a multilayer printed circuit board (PCB) (see Abstract and FIG. 1A-1J) having a dielectric core 10, a plurality of dielectric lamination layers on a first side of the core (FIG. 1J), a second plurality of conductive layers on the first side of the core (FIG. 1J), and a single conductive layer 46 on a second side of the core (FIG. 1J). In one embodiment, Tsukada has a lower conductive layer 14'' (FIG. 1I, described in cols. 3 and 4) that may be patterned (FIG. 1H) to mount such components as resistors and capacitors (col. 4, lines 5-9) for supply voltage regulation, decoupling, etc. (col. 4, lines 5-9). The signal wiring conductors 40 (FIG. 1H) on the upper surface may provide SMT component mounting terminals (col. 4, lines 3-5).

The Examiner asserts that Tsukada teaches the various elements of independent claims 1 and 8. However, Applicants vigorously assert that Tsukada completely fails to disclose, among other things, that the single conductive layer comprises at least one land to couple to an input signal from a receiving substrate. Also, Tsukada completely fails to disclose “keeping an impedance variation between an input signal entering the substrate from a receiving substrate and an output signal provided to the at least one input terminal below a predetermined value”.

The Examiner further asserts that each of Bhatt and Sweitzer teaches to mount a die having a plurality of terminals on an underlying PCB. The Examiner further asserts that it would

have been obvious to mount a die on the upper surface of the Tsukada PCB. The Examiner states that it would have been obvious to provide solder balls and their associated lands at the bottom surface of Tsukada (FIG. 11), as shown in the cover figure of Bhatt, in order to provide electrical connection to an underlying or “receiving” substrate.

Applicants vigorously assert that to combine Tsukada with either Bhatt or Sweitzer, as the Examiner suggests, would impermissibly go beyond the stated intent and disclosure of Tsukada, Bhatt, and Sweitzer.

Each of Applicants’ independent claims 1 and 8 recite that the substrate keeps an impedance variation between an input signal entering the substrate from a receiving substrate and an output signal provided to the at least one input terminal below a predetermined value. As Applicants pointed out earlier, Tsukada totally fails to disclose “keeping an impedance variation between an input signal entering the substrate from a receiving substrate and an output signal provided to the at least one input terminal below a predetermined value”. Tsukada totally fails to disclose any input signal passing into substrate 10 from an underlying receiving substrate or any input signal passing through substrate 10 to an input terminal of an overlying die. In Tsukada, conductor 46 on the lower surface of substrate 10 is a power supply conductor (col. 4, line 3). The Examiner will appreciate that power supply conductors and signal conductors are different.

Applicants also vigorously assert that Bhatt and Sweitzer disclose completely different substrate structures from that recited in Applicants’ claims 1 and 8. Bhatt and Sweitzer disclose and focus on high-density multi-layer substrates with a symmetrical stack of alternating conductive and dielectric layers. See, for example, FIG. 1 of Bhatt or FIGS. 3B and 4 of Sweitzer. This is in clear contrast to Applicants’ asymmetric stack in which multiple conductive layers lie above a dielectric core and only a single conductive layer lies below the core.

A significant advantage of Applicants’ recited structure is that by increasing the separation distance between a conductive land on the bottom layer, induced capacitance between the conductive land and the next closest conductive layer is significantly reduced, by an example factor of 30/800 (.04 or 96%). As a result, impedance variation between an input signal entering the substrate from a receiving substrate and an output signal leaving the substrate to an input terminal of the die is kept below a predetermined value, e.g. ± 10 ohms. Moreover, by eliminating conductive layers from the lower portion of the stack, i.e. below the dielectric core,

signal path discontinuities are minimized, due to the fewer number of physical joints between layers. This results in improved signal integrity and higher system performance.

Applicants vigorously assert that Applicants' asymmetric stack recited in claims 1 and 8 clearly teaches away from those shown in the prior art represented by Bhatt and Sweitzer. Bhatt and Sweitzer focus on increasing the packaging density – not on reducing the packaging density by providing an asymmetric stack of conductors. For example, Bhatt refers to “increased circuit and component density in the printed circuit boards carrying the chips and in the assemblies using them” (col. 1, lines 38-42). Likewise, Sweitzer refers to “increased packaging density” (col. 3, line 52).

For the above reasons, independent claims 1 and 8 should be found to be allowable over any combination of Tsukada, Bhatt, and Sweitzer, and Applicants respectfully request that the rejection of claims 1 and 8 under 35 U.S.C. §103(a) as being unpatentable over Tsukada in view of Bhatt and Sweitzer should be withdrawn.

Dependent claims 26-30, which incorporate all of the limitations of their respective independent claims, are also asserted to be allowable for the reasons presented above.

Additional Elements and Limitations

Applicants consider additional elements and limitations of the rejected pending claims to further distinguish over the cited references, and Applicants reserve the right to present arguments to this effect at a later date.

Allowability of New Claims 28-34

New dependent claims 28, 29, and 33 recite that the predetermined value is within the range of + 10 ohms. Support may be found, for example, on page 9, line 10 of the original disclosure.

New independent claim 31 is similar to independent claim 1 without any specific thickness limitations.

New dependent claim 32 is similar to dependent claim 26.

New dependent claim 34 recites the specific thickness limitations recited in independent claim 1.

New claims 28-34 are all asserted to be patentable over the art of record for the reasons provided above.

Conclusion


Applicants respectfully submit that claims 1, 8, and 26-34 are in condition for allowance, and notification to that effect is earnestly requested. The Examiner is invited to telephone Applicants' attorney Ann M. McCrackin (located in Minneapolis, Minnesota) at (612) 349-9592 or Applicants' below-signed attorney (located in Phoenix, Arizona) to facilitate prosecution of this application.

If necessary, please charge any additional fees or credit overpayment to Deposit Account No. 19-0743.

Respectfully submitted,

DAVID G. FIGUEROA ET AL.

By their Representatives,
SCHWEGMAN, LUNDBERG, WOESSNER & KLUTH, P.A.
P.O. Box 2938
Minneapolis, Minnesota 55402
(602) 298-8920

By /  /

Walter W. Nielsen

Reg. No. 25,539